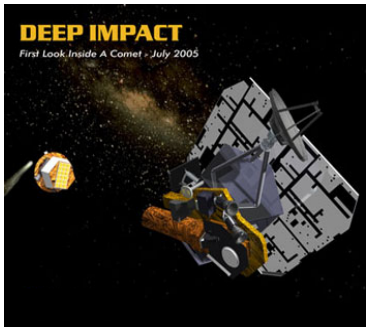

Exploring Comets and Modeling for Mission Success
Overview and Goals

Created for Deep Impact, A NASA Discovery mission
Maura Rountree-Brown and Art Hammon
Educator-Enrichment

Age group: This activity is best suited for grades 5 - 9 but some components of the module have been successfully used for grades 2 - 12 such as *Comet on a Stick* and *Make a Comet and Eat It.*

Standards alignment: Standards for this educational activity can be found at (David - please link to and include the document on Standards Alignment which is a new addition to this activity)

Purpose: The purpose of this activity is to give educators information and activities surrounding the basics of comet science. Students get the opportunity to follow the path science has taken throughout history to explore comets. They'll also learn about how we are currently exploring comets and why mission teams perform modeling exercises on Earth in order to assure mission success in space. Students learn the physical and chemical properties of comets, as we presently understand them.

More background on the mission: Educators can get more background on the mission at:

Pre-Encounter: http://deepimpact.jpl.nasa.gov/mission/factsheet2-bw.pdf

Post Encounter: http://deepimpact.jpl.nasa.gov/mission/factsheet-postencounter.pdf

Introduce background on the mission to students prior to using "*Interesting Comet Facts"*

GOALS

Students:

- Have the chance to interact with the rest of the class discussing theories on the formation and structure of comets
- Add and eliminate comet theories as they incorporate experiment and inquiry
- Make an ice cream model to visualize comet formation and the technologies used in a comet space mission
- Progress from talking about comets to creating models to test their own space designs and comet theories
- Begin with questions and perceptions about comets and progress to building their

own solid base of comet knowledge

Educators:

- Enhance their information about comets in general and the Deep Impact mission in particular
- Integrate historical information into classroom lessons that give people a personal connection with comets
- Employ comet modeling activities that use common household items: One that simulates comet formation and composition using ice cream, and another simulation that uses recyclable materials to give students experience with a common mission practice – evaluating and modifying models
- Encourage communication among students using prompts about comet characteristics, composition and formation
- Use resources that encourage thinking, discussion and writing about comet structure and behavior
- Better understand the mechanics of ice crystal formation and micro-crystal formation in ice cream

Program Description: Comets have engaged the attention of many cultures from earliest recorded history. Students duplicate the sequential path scientists have taken throughout history to research comets.

Scientists:

- Formed questions by looking up at the sky and through the drawings of others. They theorized about what might be true of comets.
- Expanded knowledge through the use of math, science and eventually emerging technologies. Using these technologies, they began to understand more about comets.
- Develop space exploration and ground observation. Robotic spacecraft visit comets. Mission teams model comets while the spacecraft is still on Earth to test and solve challenges to their mission design.

There are many reasons to explore comets both for knowledge and for future resource and protection of the Earth. The underlying goal for this activity is to lead the student from casual observation to an involvement and ownership in comet science.

Students Objectives:

- Elicit #1 - Think how they would initially define a comet based on their current knowledge and possible misconceptions
- Elicit #2 - Model an "ice cream comet" to learn about some of the elements that make up a comet and add to their base of knowledge through new information
- Elicit #3 – Discuss why scientists explore comets and what value they might have to us in the future
- Elicit #4 – Choose the information they might investigate about comets and

design the mission they would use
- Elicit #5 – Discuss modeling for the success of a mission and create models for their mission design and comet environment
- Elicit #6 – Research current comet space missions and their technologies

Web Materials for the Educator: The following materials are provided:

- "Exploring Comets - Overview and Goals"
- "Comet Activity Overview" (activity outline, order of activity)
- "Make a Comet Model and Eat It!" – Educator page
- "Deep Impact's Comet on a Stick!" – Educator page
- "Questions from Past Workshops" – Discussion or student test
- "Make a Comet Model and Eat It!" Activity

Web materials for Students and Educators:

- "Consider This" history page
- "A Comet's Place in the Solar System"
- "Chemistry of Ice Cream Activity"
- "Ten Important Comet Facts" – Facts about comets
- "Deep Impact's Comet on a Stick" Activity
- "Paper Comet with a Deep Impact" – Optional Activity
- "Deep Impact Fact Sheet" - Background information on the mission

Web materials for Students:

- "Exploring Comets" – Student reflection page
- "Make a comet model and eat it" – Student Data Sheet
- "C-O-M-E-T-S – Acrostic" – Facts about comets
- "Comet Models based on the Deep Impact Mission" Activity
- "Deep Impact – Interesting Facts" – mission background

Additional materials you will need to provide:

- Materials for the "Make a Comet and Eat It!", "Comet on a Stick", or other activities you choose from this package
- Household or arts and crafts items to make comet models
- Poster board and pens or enough blackboard space to retain several class discussion lists
- Computer to look up mission web sites for research
- The Deep Impact web site: http://deepimpact.jpl.nasa.gov

Questions?

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